Department of Health
and Social Security

Welsh Office

MCO 291

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HEALTH TECHNICAL MEMORANDUM

FIRE SAFETY IN HEALTH CARE PREMISES
Furniture, Furnishings, Bed Assemblies, Apparel

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Introduction

This publication, the issue of which was announced in HC(82)12, replaces the booklet "Fire Risks Associated with Furniture, Furnishings and Textiles" issued to Health Authorities in June 1976 under cover of HN(76)80 and to Local Authority Social Services Departments in August 1976 under cover of LASSL (76)17. It is intended as a guide for those who purchase and/or use furniture, furnishings and textiles in health care buildings, and others with a responsibility for fire precautions in the National Health Service.

Some chapters and Appendices are of special interest to particular disciplines as will be evident from the contents page, and whilst much of the content relates to hospitals, the principles propounded apply also to other health care premises.

This Memorandum, together with related technical memoranda on design and both general and certain specialist aspects of fire safety, constitutes the "Memorandum of Guidance" to which reference was made by the Home Sectetary in a Statement[a] in the House of Commons on 23 April 1980. As such, it supplements the Home Office's Draft Guide to Fire Precautions in Hospitals, dated September, 1982.

References are made in the text to the Health Service Supply Purchasing Guide (HSSPG), a DHSS publication circulated to Health Authorities only, which contains details of items available under contracts arranged centrally, and of suppliers and specifications in respect of some other products. For any products covered by those references, it is suggested that Local Authority Social Service Departments should seek the collaboration of the Supplies Officer of the appropriate Health Authority. Some of the products are already directly available to Local Authorities under arrangements made by the Property Services Agency (PSA) of the Department of Environment (DOE).

Health Authorities will need to exercise control over patients' clothing available through hospital shops to ensure that it complies with advice given in this publication. For the same reason, staff who accompany patients on shopping expeditions or who are in contact with relatives about brought-in clothing will need to know of this advice.

In HM(69)58 advice was given to Health Authorities about financial contributions from voluntary bodies and other sources. It is the responsibility of Health Authorities to ensure, as far as is possible, that all items donated or purchased with financial contributions from such sources are suitable for use by, or for the care of, patients. In the context of this publication this means that the items should be of a reduced fire hazard level where such a quality is available. To achieve this Health Authorities should endeavour to secure advance consultation with organisations, such as Leagues of Friends and Rotary Clubs, which propose making gifts.

The advice now given is commended to health authorities though it is appreciated that any action taken to follow it depends on financial resources available and the priorities of competing demands upon those resources.

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[a] Hansard, Written Answers, 23 April 1980, cols. 139–141

1 General

Scope

1.1 This publication deals with a certain fire safety level in health buildings by identifying non-building materials which, when used by themselves or in conjunction with others, do not ignite easily and have a low flame-rate and spread, so that the development of fire, if not prevented altogether, is at least delayed. Thus the early detection of a fire will afford time for putting it out and for evacuating patients before flames and the products of combustion make the environment untenable.

1.2 Guidance is provided on the purchase of such materials, textiles in particular, and their behaviour when subjected to fire.

Background

1.3 Flammability is a relative matter and the flammability of furniture, furnishings and textiles varies with the magnitude of the hazard posed. There is no truly "flameproof" material; and the best that can be achieved is a given level of resistance to fire, thereby reducing the fire hazard level.

1.4 The fire behaviour of furnishings, textiles and supports (eg mattresses) used in health care facilities is cause for concern. The fire hazard risks of these materials, and the smoke and toxic gases produced by their combustion cannot be entirely reduced or contained by operational means, such as improved methods of escape, fire detection or smoke extraction.

1.5 A high proportion of fires in hospitals originate in wards. By far the most frequent cause of such fires is smokers' materials which when lit and handled carelessly could result in a major fire. It is recognised that ward staff play a leading role in the supervision of smokers and the detection and confinement of fire.

1.6 Advances in materials technology may gradually decrease the fire risk but will not eliminate it entirely, and it is, of course, essential that materials used on and around the patient should provide comfort and be aesthetically acceptable. It is stressed that particular products are referred to in this text because they are acceptable in relation to flammability — no claims are made for clinical efficacy.

2 Furniture

General

2.1 This chapter deals with furniture in wards and other hospital areas used by patients. The degree of fire risk of individual items is mentioned, where appropriate, and information is also given about the availability of items with a reduced fire hazard level.

Furniture in wards

2.2 Ward furniture apart from bedsteads and some divans is mainly made from wood and is therefore relatively difficult to ignite. It can, however, contribute significantly to a fire once the fire has developed, and the spread of flame will vary with the amount of furniture and its position. The degree of risk therefore varies with particular situations. Furniture for especially high-risk areas is dealt with in paragraph 2.5, 2.7 and 2.8.

Bedsteads and divans

2.3 Most bedsteads in ward areas, other than those for long-stay patients, are likely to be of the King's Fund or other all-metal type and will not present a fire hazard. Where divans are used it is recommended that these should be of an all-metal frame construction. However, it is accepted that local judgements which should be backed by the Health Authority may lead to the use of solid timber beds where it is considered there is a balance of advantage for the particular patients concerned (for example, through the creation of a more homely environment) in allowing a margin of risk to arise. To minimise fire risks such beds should have a flame retardant finish having Class 1 rating for spread of surface flame to British Standard BS 476: Part 7. If headboards for divans are considered essential they should be faced on both sides with a finish to a standard equivalent to that of melamine laminate with the same Class 1 rating for spread of surface flame. The edges should be lipped with an intumescent lacquer finish.

Overbed tables

2.4 Overbed tables should be to BS 2483.

Solid screens for long-stay ward areas

2.5 The policy of creating a more domestic environment for long-stay patients has led to a desire to provide such patients with greater privacy by sub-dividing multi-bed areas. Fixed solid screens only should be used to give fire protection between sub-divided areas. It is essential that such screens retain their integrity against flame and hot gases and in addition should not conbribute to a fire nor cause a speedy rise in temperature, nor allow heat transfer. 'Type C' screens (ref HN(77)144, Type 'C' furniture for long stay patients) satisfy these requirements.

Carcass furniture

2.6 The term "carcass furniture" covers any item of furniture having some totally enclosed interior space, normally provided by doors or fronts of drawers. Such furniture can also include one or two open compartments. Bookshelves provide storage but do not strictly rate as carcass furniture, nor do work/leisure surfaces which form part of the 'Type C' range.

2.7 In ward areas for long-stay patients, where there is often a high risk of fire and where greater storage facilities are required, it is recommended that only furniture which meets the specifications referred to in HN(77)144 should be used. The 'Type C' range includes wardrobes, drawer and cupboard units, dressing tables and work/leisure surfaces, shelving for storage or display, and headboards (see para 2.3). The specifications provide for all exterior finishes, and interior finishes of wardrobes, to have a Class 1 rating for spread of surface flame. Full scale tests have shown that furniture made to such finishes limit the rate of temperature increase as well as the level of temperature attained.

2.8 Backless wardrobes for attaching to screens can be used providing the fixing is very carefully done leaving no gaps which would allow flames to spread. A scheme using backless wardrobes would, of course, be less flexible than one using free-standing wardrobes.

Wooden-framed upholstered chairs

2.9 The Department is in close touch with the long term research projects concerned with the flammability of furnishings being carried out by the Home Office and the Department of the Environment (DOE). Up to now the work has been concentrated on the ignition of various upholstery covers and foam infills. When ignition has occurred, the hazards of smoke and toxic gases will still remain. Research has shown that it is possible to produce upholstered wooden-framed seating (upright, easy and semi-easy chairs) which is flame retardant (FR) to an acceptable standard. BS5852 Part 1 details test methods for ignition by smokers' materials, ie a smouldering cigarette and a lighted match. However all upholstered chairs currently available from DOE/PSA central contracts for the NHS are required to meet a higher ignition source

standard namely, DOE/PSA Fire Retardancy (FR) Specification No 6, ignition source 5 which applies to the chair as a whole. Tests which have been conducted indicate that once there is ignition and the flames penetrate the polyurethane foam infill of the chair, the fire develops quickly and with it the additional hazards of smoke and toxic gases already mentioned. The type of upholstery cover material is therefore of the utmost importance. The vinyl cover materials listed here have been successfully tested to the relevant FR standard.

Ambla 803
Baltic FR
Cirrus 349
Hilon
Lionella FR3

2.10 Other covers available from DOE/PSA central contracts also meet the required FR standard. These include fabrics made from 100% wool, and wool blended with a variety of man-made/synthetic fibres (see HSSPG Section T). In most cases an interlining of FR calico is used in conjunction with these materials in order to achieve the necessary pass standard in accordance with FR Specification No 6 and related ignition source 5. It follows that protection by an approved covering material will cease to be effective if the material is torn or damaged. Care should be taken to ensure that only approved materials are specified for the re-upholstering of chairs.

Metal-framed upholstered chairs

2.11 Being metal-framed, this type of furniture is a lesser fire risk than wooden-framed seating. Nevertheless, the upholstery is just as vulnerable and the same FR standards apply. There are DOE/PSA central contracts for metal-framed seating, including dining chairs, swivel office chairs, typist/posture chairs, easy chairs and bench seating, and, like the contracts for wooden-framed seating, specify the same FR standard.

Polypropylene chairs

2.12 It has been found possible to produce a polypropylene chair which will meet the same FR standard as for wooden and metal framed seating. As a result, the current DOE/PSA central contracts include chairs which have differing FR levels. The standard ranges of chairs, both upholstered and non-upholstered, will meet FR Specification No 6 to a level of smokers materials only (FR Specification No 10, ignition sources 0 and 1 — match and cigarette). These chairs can be used in patient areas where there is a low fire risk. However, a special chair, which is non-upholstered, has been added to the contracts which will meet the much higher ignition source 7. This chair is designed primarily for use in the high fire risk areas.

Loose covers

2.13 If there is a specific requirement for loose covers these should meet the FR standard for upholstery detailed in the FR Specification No 3 and related ignition source 5. There are no central contracts for loose covers but replacement covers are available to fit the PSA Whitley Range of office seating. (See HSSPG, Section T). However, it should be noted that these covers are not flame retardant and, if specified, they should be used only with an acceptable FR interliner.

3 Furnishings

Curtains (cubicle, window and mobile screens)

3.1 Curtains, and particularly cubicle curtains, should be flame retardant. Fire spreads more rapidly upwards than sideways and unless contained it will spread, usually gathering momentum as it proceeds. Cubicle curtains around a bed can play a significant part in containing a bed fire.

Cotton fabrics

3.2 Proban and Pyrovatex treated (see Appendix 3) cotton fabrics are recommended materials. These meet BS5867 Part 2 (amended) requirements and are available in piece lengths and as made-up curtains in a wide range of patterns and colourways under DOE/PSA central contract (see HSSPG, Section T). (For matching counterpanes see Section 4 of HSSPG, sub-section 4.1.4). It must be emphasised that the flame retardant effectiveness of all chemically-treated FR fabrics is dependent on the correct laundry procedures being followed.

Other fabrics

3.3 100% spun modacrylic fibre curtains are also recommended and should meet BS5867: Part 2 (amended) but after one wash. Testing of 100% polyester curtain fabrics is continuing and it is hoped that with slightly altered criteria, these will be available for health care premises in the near future.

3.4 FR curtain lining is available from DOE/PSA contractors and should be used if FR curtains are to be lined. Blackout curtaining material in a FR fabric is also available on central contract. Net curtains and net curtaining materials of 100% polyester fibre which meet FR Specification No 7, using ignition source 5, are also available under central contract.

Blinds

Venetian blinds

3.5 These are available under DOE/PSA central contract and, although not specifically described as

flame retardant, can be so regarded because only blinds with metal slats are supplied to Health Authorities.

Roller blinds

3.6 Roller blinds made of fibreglass or a Proban or Pyrovatex treated material are obtained on a supply and fix/supply basis on DOE/PSA central contract. The FR standard is that defined in FR Specification No 7, using ignition source 5.

Floor coverings

Soft floor coverings (carpet/textile)

3.7 Soft floor coverings are not considered to be a serious fire hazard but all makes of soft floor covering used should have been tested to BS4790 and rated as defined in BS5287.

3.8 Carpets rated as "high radius of ignition" are not available on DOE/PSA central contracts. Carpets rated as "low radius of ignition" should be used in areas designated as being high fire risk. Soft floor coverings bonded to the floor present a lower fire risk than soft floor coverings loosely laid.

Hard floor coverings

3.9 The Fire Research Station does not consider hard floor coverings a fire risk. Nevertheless, some floor coverings such as linoleum and PVC sheets and tiles will add to the overall fuel loading, but by the time they ignite any furniture and furnishings in the location would be well alight.

4 Bed Assemblies

Textiles

General

4.1 Ignition of textile products such as bedding and clothing is the principal cause of injuries to most patients involved in fires. Burning characteristics and the interval between the onset of heating and ignition (ignition time) may vary with the fibre type. It may be influenced by the yarn and fabric construction and the manner and conditions under which they are used.

4.2 Synthetic fabrics are now commonly used in health care, such as polyester, nylon and blends of natural and synthetic fibres, polyester/viscose or cotton, and of course, cotton and wool with, to a lesser extent, modacrylic fibre fabrics.

4.3 The synthetic fibres used are thermoplastic, with relatively slow burning and some melt occurring when certain temperatures are reached. In an unrestricted fabric this allows the hot melt, quite often with flame, to drop away, leading to the extinction of the flame. Polyester fibre, commonly used for fillings in clothing and bedding to aid warmth retention, *has altered burning characteristics when contained in this form.* Containment of the melt within the fabric enclosure prevents 'drop away' and flame extinction, resulting in rapid flame spread.

4.4 Wool is inherently flame retardant but the flame retardancy can be influenced by fabric mass and construction. Low weight open-weave wool fabrics below 140 grammes per square metre (gsm) should not be used. The FR effectiveness of wool, depending on weight and construction, can be increased by a chemical finish although it will still burn if exposed to an intensive heat source.

4.5 Man-made rayon fibres, except those containing FR additives, as well as cotton, and blends of cotton with other man made fibres, will burn and depending on the use condition, be destroyed. Chemical finishes which lower the fire hazard of some of these fibres are available and in use.

4.6 Two synthetic fibres with vastly different hazard levels are acrylic and modified acrylic (modacrylic). *Acrylic fibre fabrics should not be used in health care; they are a high fire risk.* Modacrylics, however, will considerably lower the fire hazard level for clothing and bedding, and for many applications, where the laundries are conversant with this fibre, their use is to be encouraged.

4.7 Low fire hazard level materials will help to provide a safer environment against fire, but note must be made of recommended constructions and mass for a particular product and the manner of its use. These factors can alter the important delay time to ignition and eventual burning behaviour. Bed assemblies in which the sheets, blanket and counterpane are all made from 100% spun polyester fibre fabric *should not be used.* It is recommended that the blanket and/or counterpane should be made from cotton treated with Proban or Pyrovatex or from modacrylic fibre fabric. Further recommendations may be made following tests on different bed assembly materials being arranged by DHSS.

Blankets

4.8 The following four types of blankets are recommended for high-fire risk areas.

Wool (reduced fire hazard level treated)

4.8.1 This remains a recommended blanket for high-fire risk areas and should be purchased to BS5866: Part 1 and with the IWS flame-retardant treatment (ie ZIRPRO process) to meet the requirements of BS5867: Part 2 (amended).

Cotton cellular (reduced fire hazard level treated)

4.8.2 Cotton blankets should be purchased treated with Proban or Pyrovatex and should meet the requirements of BS5867: Part 2 (amended) after 200 washes. The construction of the blankets should be in accordance with BS5866: Part 2.

Polyester cellular

4.8.3 100% spun polyester blankets are available in woven and knitted constructions. Woven blankets should be purchased to BS5866: Part 2 for construction and, when published, to BS5866: Part 3. A blanket of knitted construction for which the supplier has submitted a UK Patent Application, is now available. There is as yet no BS applicable but it will be eventually incorporated into BS5866: Part 3. Flammability requirements for both types should meet BS5867: Part 2 (amended) but after one wash, and this requirement is also applicable to blankets made from FR polyester fibres.

Modacrylic cellular

4.8.4 Modacrylic blankets should be purchased to BS5866: Part 2 and in due course, to BS5866: Part 3. Flammability requirements should meet BS5867: Part 2 (amended) but after one wash.

Sheets and Pillowslips

4.9 Sheets have long posed a problem in the provision of both comfort and a low fire hazard level. Additive treatments that have been effective in lowering the fire hazard level of cotton and other cellulosic fibres have unfortunately, until very recently, given fabrics a harsh and stiff handle. The problem of satisfactorily treating polyester/cellulosic sheets that will retain a low fire hazard level integrity after 200 washes is still being researched. Cotton, treated with either the Proban or Pyrovatex process, meets DHSS flammability requirements after 200 wash cycles. 'Handle' and compatability to the skin, according to Ciba Geigy Ltd who manufacture the Pyrovatex chemical, presents no toxicity problems. Albright and Wilson Ltd the Proban chemical manufacturers have over the years modified their process to give a better 'handle' and skin compatability without toxicity problems.

4.10 Both systems can provide acceptable low fire hazard level sheets and pillowslips but at a considerably increased cost.

4.11 Polyester, which has only recently entered the sheet field as a 100% fibre fabric, is beginning to gain acceptance as providing comfort, inherent low flammability, and quick water shedding leading to laundry economy. Initial reaction to small scale trials in individual hospitals has been encouraging.

Counterpanes

4.12 Counterpanes should be flame retardant. They should be kept on the bed at all times, and, consistent with the patient situation, should cover the other bedding textiles as completely as is possible.

4.13 Counterpanes are available under DOE/PSA central contracts in curtain fabric to a minimum mass of 280 gsm. They are FR treated to meet contract flammability requirements using the Proban or Pyrovatex process. Dobby weave counterpanes to the mass and weave constructions of DHSS Specification TSS/S/310,535 (see HSSPG, Section V) are acceptable if Proban or Pyrovatex treated to meet the requirements of BS5867: Part 2 (amended) after 200 washes. Polyester or modacrylic woven counterpanes of a minimum mass of 280 gsm are acceptable provided they meet the requirements of BS5867: Part 2 (amended) but after one wash, and this requirement is also applicable to counterpanes made from FR polyester fibres.

4.14 Any of the types of counterpane detailed above may be used in high risk areas but it is stressed that they should meet the relevant requirements.

Quilts

4.15 It is acknowledged that quilts (continental quilts, duvets or eiderdowns) provide a high ratio of warmth for weight and permit greater freedom of movement for the patient. There is also an advantage in simplicity of bed making. There are, however, difficulties in laundering because of their greater bulk creating low machine loads.

4.16 The present difficulty with quilts of the type most likely to be used in hospitals (ie those having a polyester filling), is the increased fire hazard over the more conventional hospital bedding where a FR counterpane is used. Some currently available types of quilts and eiderdowns, even if provided with FR covers, increase the bed fire hazard. Polyester filling will flame rapidly within the containment of a cover when molten fibre cannot drop away. FR covers can "break through" at a charred area allowing combustion of the filling or, if a polymer fibre is used as a cover (eg polyester) molten fabric from a small ignition will 'hole' the cover allowing possible combustion of the filling.

4.17 The use of FR polyester infill, of which several types are available, will, in combination with a complementary cover, give a low fire hazard level quilt.

4.18 The four types of quilt ('continental') listed below are acceptable and have been tested to FR Specification No 5. In addition, these types of quilt, when provided with an inherently FR secondary cover of 275 gsm mass, in either Proban or Pyrovatex treated cotton, 100% spun modacrylic or 100% spun polyester fibre, have also been tested satisfactorily to FR Specification No 10, ignition source No 4.

4.18.1 Infill: ICI FRX flame retardant polyester tow, Type 579

Primary cover: Proban or Pyrovatex treated cotton

Secondary cover:

i Proban or Pyrovatex treated cotton (Mass 275 gsm)
ii 100% spun modacrylic (Mass 275 gsm) or
iii 100% spun polyester (Mass 275 gsm).

4.18.2 Infill: ICI FRX flame retardant polyester tow, Type 579

Primary cover: Low flammability, thin PVC sheeting to BS1763 — pattern printed on one face.

Secondary cover:

i Proban or Pyrovatex treated cotton (Mass 275 gsm)
ii 100% spun modacrylic (Mass 275 gsm) or
iii 100% spun polyester (Mass 275 gsm).

4.18.3 Infill: FSM1 treated feathers

Primary cover: Proban or Pyrovatex treated cotton

Secondary cover:

i Proban or Pyrovatex treated cotton (Mass 275 gsm)
ii 100% spun modacrylic (Mass 275 gsm) or
iii 100% spun polyester (Mass 275 gsm).

4.18.4 Infill: Resin bonded flame retardant polyester fibre (National EP1713)

Primary cover: Proban or Pyrovatex treated cotton or 100% spun polyester

Secondary cover:

i Proban or Pyrovatex treated cotton (Mass 275 gsm)
ii 100% spun modacrylic (Mass 275 gsm) or
iii 100% spun polyester (Mass 275 gsm).

Incontinence pads — washable

4.19 One of the incontinence pads available, the Kylie absorbent bed sheet, is both re-usable and of low flammability. In the standard model, 'tuck-in' flaps of cotton are attached to the longer edges of the sheet. For health care use however the sheets should be purchased with 100% spun polyester fabric 'tuck-in' flaps.

4.20 This sheet is not designed to exhibit low flammability characteristics, but use of its brushed nylon layer on top, with a minimum use of the more flammable material does allow it to have a satisfactory FR rating when tested to BS2963 enabling it to be described as of low flammability after 12 washes as defined in BS3121. Where an incontinence pad is used in a fire risk/incontinence situation, the Kylie absorbent sheet is recommended.

4.21 The Kylie sheet has a life of over 100 washes and because its low flammability is inherent in the top layer, it will not alter with the wash frequency.

Fleece underlay — washable

4.22 The 'Mullipel' fleece now available is a dense polyester fibre pile with a total mass of 1250 gsm including the knitted, coated backing. Its pile fibre mass is 980 gsm. Sixty washes have been successfully carried out on this fleece at 71°C followed by both tumbler drying and autoclaving. Horizontal flammability testing of the pile surface, using FR Specification No 4, produced a pass to all three ignition sources O, 1A, 3B. The fleece backing has passed BS5867: Part 2 (amended).

4.23 The underlay is recommended where a fleece is necessary in a fire risk situation as an alternative to the now rarely used and more expensive natural fleeces and the commonly used natural fibre on synthetic fibre backing. It should be laid horizontally on the bed with the pile uppermost. The low flammability is inherent in the pile and density; it will not alter with wash frequency.

Patient supports

Comfort

4.24 Any supporting surface on which a patient lies must not adversely affect his or her condition. A good support should provide as extensive an area of support as possible to reduce the load taken by the prominent bony areas, as an aid to inhibiting the development of pressure sores. These requirements are most easily achieved at present by the use of the central contract polyurethane foam core mattress, which is constructed to provide that correct postural support, with a polyurethane coated nylon fabric waterproof cover and with only one textile sheet between patient and mattress. Other conventional mattresses are much less effective while only Low-Air-Loss and water bed systems provide greater support advantage.

4.25 In fire risk areas, the central contract spring interior mattress is recommended where clinically superior postural support is not essential (although it will provide superior support compared with other types of spring interior mattresses). All materials enclosing the spring unit should have a reduced fire hazard level, either inherently or by a chemical system finish to prevent, as far as possible, the support of smouldering or flaming combustion or afterglow, and so delaying the spread of flame.

4.26 Development of a new concept in patient supports has started. The design which involves high void volume fibre constructions, will maximise the load-bearing characteristics in parallel with the use of low fire hazard level materials.

4.27 Consideration is also being given to integral cover systems for the polyurethane foam core in conjunction with a thin layer covering of the foam, to reduce the risk of ignition and core involvement in a bed fire. Both cover systems and thin layer coverings when developed should retain low fire risk integrity and have permanent adhesion for the life of the support.

Mattresses and mattress covers

4.28 All mattresses suitable for health care use in a bed assembly burn readily in a developed fire. In certain conditions both the integral cover on the contract spring interior mattress and the removeable cover on the polyurethane foam core mattress will delay fire involvement of the interior and core respectively.

4.29 Additional protection is provided for both types of support by fitting a FR stretch primary cover which conforms to mattress body loading deformation. This is now available for fitting to mattresses already in use in hospitals. It should be fitted between the polyurethane coated proofed nylon cover and the polyurethane foam core of central contract mattresses. It can also be fitted to the spring interior mattress, whether or not used in conjunction with the proofed nylon mattress cover. This new primary cover on a foam core has been successfully tested to FR Specification No 4 — ignition source No 4 and 5 as defined in FR Specification No 10.

4.30 A brief description of this cover is: primary mattress cover of Proban or Pyrovatex treated, knitted, single loop pile, jersey, terry fabric, mass 250 gsm minimum.

4.31 All patient supports used in a health care facility should be covered with available low fire hazard bedding materials that will:

1. Provide high resistance to ignition — particularly small flame sources such as a lighter or a lighted match or burning cigarette.

2. Delay involvement in an already developing fire by resisting flame spread.

Pillows

4.32 Pillows do not present a serious initial hazard since fires do not generally originate in them but they can add to the fuel load in a bed fire. Subject, therefore, to nursing considerations, the fewer used for support purposes the better. In risk areas, pillows should be purchased with a fixed Proban or Pyrovatex treated primary cover and should be used with a similarly treated pillowslip. Both pillow and slip should be labelled to ensure their continued composite use. Where pillows are available with an infill of either FR polyester or additive treated FR polyester, these are also recommended in risk areas. The sewn-on primary pillow covers should be in Proban or Pyrovatex treated cotton or in the knitted stretch terry fabric as described in paragraph 4.30 above. A pillowslip in 100% spun polyester fabric is acceptable for this assembly.

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5 Apparel

General

5.1 Clothing suitable for patients in hospitals that will afford comfort, wash/wear properties and appearance retention is not available in FR fabrics. However, fabrics are available that have been finished with chemical additives such as 'Proban' and 'Pyrovatex' on cotton or the IWS FR treatment on wool. These will provide a high degree of flame retardance throughout a garment's useful life. Other fabrics are available made from synthetic fibres that have an inherent degree of fire retardance, such as the modified acrylic (modacrylic) and polyester. It is important when choosing a garment which is intended for patient use that, if any item of clothing is in a low fire risk fabric, trimmings should be kept to a minimum and must be of the same fibre or finish as the main fabric. Sewing threads must be synthetic in polyester or nylon continuous filament or staple fibre.

Clothing combinations and hazards

5.2 Care must be taken with combinations of clothing which can increase the fire hazard. A polyester fibre garment worn over untreated cotton is a low risk because the outer garment once ignited would be slow burning. With these two fabrics in reverse order there is a high risk as heat from the ignited cotton outer garment can melt thermoplastic synthetic fibres which adhere to the skin, and because the melt is contained the fibre will burn. *Acrylics are extremely flammable.* Clothing of any type made from acrylic fibre eg 'Courtelle', 'Acrilan' or 'Orlon' should *not* be used. Modacrylics, however, are difficult to ignite and do not sustain flame. These can be satisfactorily washed at 71°C, the disinfecting temperature. However, tumbler drying, where higher temperatures are attained, may cause considerable shrinkage, discoloration and creasing.

Outer fabric protection

5.3 The outer fabric of garments, in some low fire hazard level fibres, does provide protective action to flammable fabrics worn underneath; although the action will depend strongly on the fabric construction and weight. FR cotton, FR viscose, wool, modacrylic and polyester provide a delay to ignition of inner fabric, either because of their inherent properties of not easily igniting, or by leaving a coherent insulating charred residue (as in the case of the FR cotton and viscose, modacrylic and wool).

Sleepwear

5.4 Fabrics for these garments must meet BS5867: Part 2 (amended) and should be spun polyester or

modacrylic in plain weave with a mass of not less than 119 gsm to provide a low fire hazard, comfort, and easy laundry care. Cotton sleepwear, provided it is Proban or Pyrovatex treated, is also recommended, but greater care in laundering will be needed otherwise garment appearance will suffer. If available, FR viscose is acceptable but caution must be exercised with laundry treatment to provide an acceptable finish. *Polyester-cotton, acrylic, viscose or cotton should not be used.*

Dressing gowns and bed jackets

5.5 Fabrics should meet BS5867: Part 2 (amended). Wool or modacrylic are equally satisfactory from a flame retardancy point of view. Wool may be chemically treated for improved flame resistance safety and will naturally provide comfort and appearance but to retain these latter properties, laundering, even where 'machine washable wool' has been used, can cause problems. Polyester in textured yarns will provide warmth, low fire hazard level, appearance retention and ease of laundering. Quilted dressing gowns and bed jackets (which will most probably contain polyester or acrylic fibre filling) should not be used unless it is ensured that the infill is FR treated polyester and has been enclosed in a polyester of chemically FR treated fabric. A 76% modacrylic/24% polyester knitted terry pile fabric is recommended for dressing gowns.

Underwear

5.6 Provided a low flammability fabric (such as recommended in 5.7) is worn as the over-garment, underwear may be cotton, wool, nylon, polyester, or a 50/50 blend of polyester T556 and Vyloft viscose fibre.

[HSSPG Letter 85(78)V4 gave details of suppliers of polyester soft spun knitting fibre T556 and of suppliers of garments made from these fibres].

Day outerwear

5.7 Clothing provided for day wear should be preferably 100% spun polyester or 100% modacrylic fibre fabrics. Wool, particularly, if FR treated, is also recommended, but it is unlikely that it will meet the desired price range or laundry acceptance. Garments should, if possible, have a minimum fabric mass of 200 gsm. Garment styling need not be severe or restrictive if a FR fabric is used. Trim should be compatible with the main fabric and sewing threads should be of 100% spun polyester.

6 Disposables

Sheets, pillowslips and drapes

6.1 Regular use of disposable products continues to increase as emergency alternatives when supplies of conventional textiles are interrupted. Special care is needed as those at present available have a high fire risk being made from paper and textile materials. Treated disposables suitable for hospital use, while being marginally safer, should be also used with caution.

It is not intended to discourage the use of disposables but Hospital Equipment Information Bulletin No 85, item 57/80, draws attention to the difficulty of supervising patients who smoke. It includes details of an incident in which a patient sustained first degree burns when disposable sheets and bedding were ignited. The danger of rapid ignition of disposable bedding cannot be overstated when patients smoke in bed, and particularly so if they are immobile.

Incontinence pads

6.2 Disposable incontincence pads can be easily ignited, even when being used. No flame retardant type of pad is available. See HEI Bulletin No 85 item 57/80 as above.

7 Fire Behaviour

Reaction to fire

Furniture

7.1 Solid timber in furniture is a relatively low fire risk until a fire has gained a stronghold. Whilst relatively difficult to ignite in the first place, it can contribute significantly to the fire once it is alight. The volume of such furniture and its positioning within a given space is significant to the spread of fire.

Textiles

7.2 While various processes may take place when a textile is exposed to a heat source the important factor is that only a relatively small heat output is normally required to bring about thermal decomposition and in most cases initiate combustion. A match flame or a glowing cigarette will decompose, at least locally, most commonly used textiles.

7.3 Ignition occurs when the flammable products from the thermally decomposed textile are heated in the presence of oxygen. Because textiles are generally used in the form of 'thin' fabrics, there is normally a large excess of available air, and consequently a small ignition is usually sufficient to cause ignition with flaming, although in some cases, only smouldering or glowing may occur. Generally, the heavier the fabric the longer the igniting flame must be applied to initiate combustion, most of this time being required to bring about sufficient thermal decomposition.

7.4 Certain thermoplastic fibres are difficult to ignite because thermal decomposition takes place at such a low temperature that the flammable products produced are dispersed before reaching their ignition temperature. FR treatments frequently decrease the decomposition temperature of the fabric with the same result.

7.5 The effect of burning textiles on surrounding atmosphere is important in communal situations such as hospitals where, apart from their extensive use, textiles may also be stored in the vicinity. When burning is extensive, as in a conflagration, most textiles will burn with a decrease in the amount of oxygen available and dilution of that available oxygen with decomposition products. However the effect of the non-textile materials which are burning, for example polyurethane foam, is likely to be greater than the effect of the textile part of the fire.

7.6 Termination of burning of a flammable textile material does not normally occur until all the fabric in the area of combustion has burnt away. In certain circumstances, burning in a closed atmosphere may cease before all the fabric is consumed because of lack of oxygen.

Apparel

7.7 Flame spreading in garments depends both on the fabric and the garment design. Dresses made from cotton or polyester/cotton will burn to completion causing extensive injury to over 70% of the body. Dresses made from polyester, high temperature polyamide (nylon) or FR cotton fabrics, will rarely sustain combustion in single layer garments. The typical pattern of flame spread for cotton and polyester cotton dresses ignited at the front hem is up the front of the dress from the point of ignition (although not always reaching the shoulders) and then relatively slowly around the back of the dress.

7.8 Generally, an undergarment (dress/slip) that is not flame retardant under a flammable fabric dress will not affect the burning duration or heat transferred in the case of cotton or polyester/cotton fabrics. On the other hand, FR undergarments do show a reduced burn area; even a bra will provide some protection although panties will not. As mentioned above, design does have some bearing on garment flammability. In properly fitted slacks ignited at the knee, flame propagation will be slower than for the same material in a skirt ignited at the hem. Loose trousers, perhaps oversize at the waist and supported with braces, will give an enhanced rate of flame propagation. A belt in a dress will slow down the rate of flame spread and thus reduce the area of burn, although A-line dresses tested on dummies have shown that if made from polyester, wool or FR cotton fabrics, little heat is transferred causing less than two per cent of skin burns on the body.

Polyurethane foam

7.9 Previous comments about the progressive reaction of textiles to fire apply also to foam, but the severity of flaming of foam is governed by another variable — the tendency to melt or drip. Polyurethane foam will show this tendency along with a higher heat flux and a rapid increase in the smoke level.

Hazards from burning materials

Heat transfer

7.10 The burning of textiles is largely dependent on their ability, once ignited, to produce sufficient heat to cause thermal decomposition of additional fabric and combustion of their decomposition products. A large excess of heat is produced from a burning textile which is sufficient to cause ignition of other flammable material in the vicinity or to cause severe burns to the skin over the short separation distances of normal apparel. Certain fabrics either remain unaffected by heat exposure or form a solid residue. The insulating effect of this fabric or fabric residue may be important in preventing heat transfer from the igniting source to other materials or to the skin. On the other hand certain fabrics produced from thermoplastic fibres, which melt and shrink away from the ignition source forming a hole without igniting, do not provide this barrier effect. Since such fabrics do not readily propagate flame, the hazard from small ignition sources is presented by their melting characteristics.

7.11 Heat transferred from flame and hot gases is the direct cause of skin injury. Fabrics which burn rapidly can transfer enough heat to cause "whole skin loss" burns while fabrics which burn only for a short distance and then extinguish themselves will transfer only small amounts of heat.

7.12 Polyester is a restricted burning fabric transferring little heat while acrylic fabric burns rapidly and extensively, transferring sufficient heat to cause deep and extensive burns. Polyester/cotton and cotton alone lie between these two with the former transferring less heat than the latter.

7.13 Polyester fabrics present little hazard from heat transferred from flame and convected hot gases to adjacent skin, although falling molten drops of material can be a local hazard to the ankles and feet

of the garment wearer. The heat of molten material is very small compared with that from an area of burning cotton fabric.

Toxicity

7.14 When textiles burn most of the gaseous decomposition products are toxic and when large quantities of fabric are burning the volume of such products may be sufficient to endanger life. Other gaseous products and smoke particles irritate the eyes making it difficult to find escape routes, while the respiratory tract is affected making it difficult to breath. These effects may not be dangerous in themselves, but they cause panic and fear which considerably increases the danger inherent in any fire.

7.15 The behaviour of many synthetic polymers eg polyurethane foam, in a fire differs considerably from that of more traditional materials. The situation is complicated by the mixing of numerous ingredients and their potential interaction. Fire hazards posed by such interactions are not yet fully understood. As with this foam's tendency to melt or drip and cause higher heat flux and smoke levels, the importance of the relative toxicity of combustion products of this material does cause concern. Unfortunately, this is an area in which research is just beginning and little is known. The development of toxicity guidelines for the selection of materials is still in its infancy.

Testing for fire behaviour

Textiles

7.16 Testing textiles for fire behaviour provides information on flame application time to ignition (ease of ignition), the rate of flame spread, the extent of flame spread, and general behaviour such as shrinkage and melting. More specialised testing provides information on smoke obscuration and the toxic products of combustion by various Systems of analysis. In addition, temperature measurements of air and radiation are monitored.

7.17 Textiles for garments, curtains and bedding are tested by using vertically orientated strips as there is, as yet, no acceptable, satisfactory standard test for horizontal fabrics which correctly simulates the use orientation of bed textiles and coverings.

Upholstery materials

7.18 From the results of various research projects to determine the fire properties of furniture, it was found with upholstery fabrics, as with other materials, that only when the finished item of furniture is tested could a true indication of their behaviour in fire be obtained. In BS5852: Part 1 the principle of the test procedure is to subject to ignition an assembly of upholstery materials arranged to represent, in stylized form, the join between the seat and back (or seat and arm) surfaces of a chair.

8 Cleansing

General

8.1 These notes primarily relate to fabrics which have been additive chemically treated with Proban, Pyrovatex or the Zirpro process for fire retardancy. They are not intended as detailed laundry process instructions, but are included to illustrate the laundering process for those fabrics for the information of all concerned with the selection, purchase and use of textile items. As there are many variations in the types of washing and finishing equipment in laundries, individual Linen Service and Laundry Managers will formulate the appropriate washing processes which should be followed to retain the flame retardant effectiveness of chemically-treated fabrics.

Flame retardant cotton fabrics

Loading factor

8.2 The normal loading factor for cotton articles is satisfactory, but white and coloured fabrics should not be washed in the same load.

Wash

8.3 Generally, the two-wash process will be satisfactory. This means a breakwash or first wash to remove surface soiling, and a second wash at a higher temperature and alkalinity to remove more resistant soiling and to achieve thermal disinfection.

Breakwash (first wash)

8.3.1 Net washing time 3–4 minutes, high-dip level at a maximum temperature of 32°C (90°F).

Second wash

8.3.2 Net washing time 6–8 minutes minimum (at the recommended loading factor), low-dip level, and at a minimum temperature of 71°C (160°F). The basic conditions applicable to thermal disinfection requirements are contained in HM(71)49, Hospital Laundry Arrangements.

Wash materials

8.4 To minimise the risk of masking the imparted fire retardant properties by insoluble lime soaps or mineral deposits, the use of a synthetic detergent/CMC product (preferably anionic detergent), plus the addition of an alkali, is recommended.

8.5 If the water used for both washing and rinsing is softened to zero hardness a soap/CMC product plus the addition of an alkali may be used, *but* unless continual maintenance of zero hardness conditions

can be guaranteed, it is safer to use only washing materials suitable for hard water conditions.

8.6 In hard water conditions soap/CMC products should *not* be used, and sodium metasilicate should be replaced by an alternative alkali, eg sodium carbonate.

8.7 Sodium Hypochlorite (chlorine) bleach should *not* be used as it will destroy the imparted FR properties. For stain removal purposes the occasional use of hydrogen peroxide is permissible providing that bleaching is *not* carried out in every laundering cycle.

8.8 Do not use starch or other additives as they mask the flame retardant properties.

Rinse/extraction

8.9 When washing with a synthetic detergent/CMC product two or three rinses should be adequate, but if a soap/CMC product is used extra rinsing is recommended.

Undyed hospital woollen blankets

Loading factor

8.10 For use with water of 0° hardness.
Machine size 86 cm × 140 cm (34 in × 54 in).
Weight of load 32 kg (70 lb).
Degree of loading 46 g/dm³ (2½ lb/cu ft).

Wash

8.11 Water to standing dip 35 cm (14 in)
Add non-ionic detergent/CMC 570–1700 g (20–60 oz)
Add citric acid 115 g (4 oz)

Mix well, load, turn cage one revolution and stop
Heat quickly to 71°C (160°F)
Set interrupter gears to 2:1 ratio and run for 7 minutes
Stop machine and drain wash liquor.

Rinses

8.12 Two, each as follows:–

Cold water to standing dip 35 cm (14 in)
Set interrupter gears to 2:1 ratio and start
Run 2 minutes and stop.

Notes

8.13 1 Only a non-ionic detergent is suitable for use with this process.

2 Only a stainless steel caged washing machine is suitable.

3 The machine should be stopped before a liquor is run off and should not be started again until the next liquor has been run up to the full dip level.

Fabrics from synthetic fibres

8.14 Fabrics of this type such as modacrylic and polyester, are of a low fire hazard level which is not affected by the laundering process recommended for those fibres, but care must be taken in the finishing of modacrylic fibres. Generally, they are unsuitable for calendering, and excessively high temperatures must be avoided during tumbler drying.

9 Marking

Furniture

9.1 All furniture supplied under DOE/PSA central contracts is labelled or marked as follows:–

Wooden-framed seating	—FIRE RETARDANT TO DOE/FR6, IS/0/1/5
Metal-framed seating	—FIRE RETARDANT TO DOE/FR6, IS/0/1/5
Polypropylene chairs	—Standard range: FIRE RETARDANT TO DOE/FR6, IS/0/1 Special chair: FIRE RETARDANT TO DOE/FR6, IS/0/1/5

Furnishings

9.2 Items for use in health care premises should be identified by the appropriate label as follows.

Curtains

9.3 All FR curtain materials and made-up curtains purchased on central contract are supplied with the standard label (10 cm × 8 cm) shown in Appendix 4.

Net curtains

9.4 All polyester net made-up curtains and net curtaining material purchased on central contract will have a label supplied by the manufacturer with the following wording:–

FIRE RETARDANT TO DOE/PSA FR7,
IGNITION SOURCE 5

Roller blinds

9.5 Roller blinds have the manufacturer's name and date of manufacture printed on the blind material where fixed to the roller and are labelled as follows:–

FIRE RETARDANT TO DOE/PSA FR7,
IGNITION SOURCE 5

Textiles

Counterpanes

9.6 Counterpanes listed in paragraphs 4.12 to 4.14 should be supplied with standard labels (10 cm × 8 cm)

shown in Appendix 4 sewn on two diagonally opposite corners.

Blankets

9.7 The standard label (10 cm × 8 cm) shown in Appendix 4 should be sewn onto the corner of the blankets listed in paragraphs 4.8.1 to 4.8.4.

Quilt cover

9.8 FR quilt covers, both primary and secondary, should have a standard label attached (10 cm × 8 cm) as per Appendix 4.

Primary mattress cover and pillow cover

9.9 Primary covers for mattress and pillows treated with either Proban or Pyrovatex should have a standard label attached as per Appendix 4 (10 cm × 8 cm for primary mattress cover, and may be 5 cm × 4 cm for pillow covers).

Nightwear including dressing gowns

9.10 Nightdresses, dressing gowns and pyjamas in 100% polyester or cotton treated with Proban or Pyrovatex and modacrylic and modacrylic/polyester gowns should have a standard label attached as per Appendix 4 (may be 5 cm × 4 cm).

Appendix 1

RELEVANT BRITISH STANDARDS AND DOE/PSA FIRE RETARDANT SPECIFICATIONS

British standards

BS476: Part 7: 1971	Surface spread of flame tests for materials
BS1547: 1959	Flameproof industrial clothing
BS1763: 1975	Thin PVC sheeting, calendered, flexible unsupported
BS2483: 1977	Sepcification for overbed tables
BS2963: 1958	Methods of test for the flammability of fabrics
BS3119: 1959	Methods of test for flameproof materials
BS 3120: 1959	Performance requirements of flameproof materials for clothing and other purposes
BS3121: 1959	Performance requirements of fabrics described as of low flammability
BS4569: 1970	Surface flash in pile fabrics
BS4790: 1972	Method of determination of the effects of a small ignition source on textile floor coverings (hot metal nut method)
BS5287: 1976	Assessment and labelling of textile floor covering tested to BS4790: 1972
BS5438: 1976	Methods of test for flammability of vertically orientated textile fabrics and fabric assemblies subjected to a small igniting flame
BS5651: 1978	Cleansing and wetting procedures for use in the assessment of the effect of cleansing and wetting on the flammability of textile fabrics and fabric assemblies
BS5722: 1979	Flammability performance of fabrics and fabric assemblies used in sleepwear when tested to BS5438: 1976
BS5742: 1979	Textile labels requiring to be washed and/or dry cleaned
BS5852: Part 1: 1979	Fire tests for furniture. Methods of test for the ignitability by smokers' materials of upholstered composites for seating
Part 2: 1982	Fire tests for furniture. Methods of test for the ignitability of upholstered composites for seating by flaming sources
BS5866: Part 1: 1980	Specification for wool and wool/nylon blankets
Part 2: 1980	Specification for cotton cellular blankets
Part 3 (not yet published)	Specification for synthetic fibre blankets
BS5867: Part 2: 1980	Specification for curtains and drapes. Flammability requirements

Appendix 1 continued

DOE/PSA Fire Retardant (FR) Specifications

No 3 — Fire barrier standards for upholstery (seating and bedding)

No 4 — Composite upholstery ignition standard (seating and bedding)

No 5 — Flammability of beds and bedding

No 6 — Ignition standard for seating

No 7 — Ignition standard for curtains and blinds

No 10 — Ignition source standard

No 14 — Ignition standard, archival storage

British Standards and DOE/PSA Specifications are subject to review and amendment from time to time.

British Standards can be purchased from BSI Publications Manager, 101 Pentonville Road, London N1 9ND, or 10 Blackfriars Street, Manchester M3 5DT.

DOE/PSA Fire Retardant Specifications are available from Chief Librarian, Property Services Agency, Southbridge House, Southwark Bridge Road, London SE1 9HQ.

Note: 1 DOE/PSA FR Specification No 10 was withdrawn in November 1982 in favour of the smouldering and flaming ignition sources specified in BS5852, Parts 1 and 2.

2 Any mention of FR 10 in the remaining DOE/PSA FR Specifications should also be interpreted as referring to the ignition sources specified in BS5852, Parts 1 and 2.

Appendix 2

GARMENT LABEL TRADE NAME — LOW HAZARD LEVEL FIBRES

Garments labelled with the fibre trade names listed below are a low fire risk and are suitable for patients in health care premises.

Care must be exercised to ensure that the garment label indicates manufacture in 100% fibre from one of these trade names or in a blend of these fibres only. A blend example might be — SEF Acrilan 75%, Terylene 25%. The list is not exhaustive but it gives trade names for commonly used low hazard level fibres currently available from retail and/or contract outlets. Garments whose labels indicate the use of an unlisted fibre, either by itself or in a blend, should be regarded as flammable.

Identification of Synthetic Fabrics

Generic name	*Trade name*	*Manufacturer*
POLYESTER	TETORON	TEIJIN
	TERYLENE	ICI
	TREVIRA	HOECHST
	DACRON	DUPONT
	TERELENKA	AKU
	TERYAL	RHODIACETA
	DIOLEN	GLANZSTAFF-FABRIKEN AG
	LIRELLE	COURTAULDS
	TERITAL	RHODIACETA
	TREVIRA 270	HOECHST
MODACRYLIC	TEKLAN	COURTAULDS
	ACRILAN SEF (see footnote)	MONSANTO
ARAMIDE (POLYAMIDE)	NOMEX	DUPONT

Note: Acrilan is highly flammable. For such fabrics to be acceptable the trade name Acrilan should be accompanied by the letters SEF.

Appendix 3

FLAME RETARDANT TREATMENTS

Treatment of in-situ items

A number of proprietary processes for treating furniture and fabrics insitu to make them flame retardant are being marketed. *These should be treated with utmost caution.* None that has been tested can be recommended without qualification. It is extremely difficult to test whether the treatment has been applied evenly and adequately and the performance of such treatment is largely unknown. In some cases the chemicals leach out or can be removed by sponging or washing. Only permanent finishes are recommended, such as Proban for certain textiles.

Treatment of made-up items

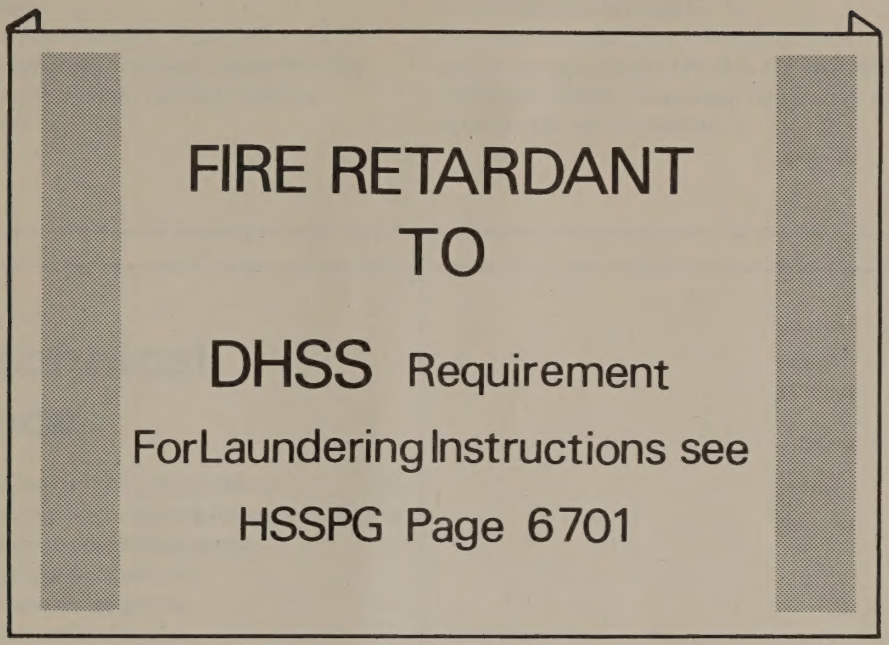
Made-up textile items such as clothing, blankets and curtains, can now be treated successfully with either Proban or Pyrovatex processes. Items should be new, in cotton only, and the labels detailed in Appendix 4 must be attached appropriately to each item treated. It is recommended that polyester/cotton or polyester/Vincel items should not be treated until flammability testing has been carried out to satisfy the Department's requirements.

Flame retardant chemical system additives or finishes

Type	*Name*	*Fabric*	*Manufacturer or Chemical Agent*
Vinyl phosphonate oligmer	Pyrol		
Organic phosphorus compound	Pyrovatex CP	Cotton	Ciba Geigy
Tetrakis hydroxymethyl) phosphonium chloride)	Proban Pyroset	Cotton	Albright and Wilson
Zirconium	Zirpro	Wool	International Wool Secretariat
Vinyl acetate copolymet with antimony oxide/ hologen complex	National EP1713		
Ammonium phosphate-sulphate	FSM1		

Appendix 4

DHSS FIRE RETARDANT LABEL — TO COMPLY WITH BS5472



Ends of label to be folded back and pressed to form double thickness

10 mm green side borders & green lettering

Sizes of label:–
10 cm wide × 8 cm — as illustrated (but not to scale)
and 5 cm wide × 4 cm

Printed in the UK by HMSO Press Edinburgh
Dd 736756 C 40 10/83

Department of Health and Social Security
Welsh Office

Prices do not include postage

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Health Technical Memoranda

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First published 1983

CI/SfB 1976
4 / (8-) / /(K4)

ISBN 0 11 320800 6